No 32.

THE Sidereal Messenger.

Conducted by Wm. W. PAYNE,

Director of Carleton College Observatory.

MARCH, 1885.

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"He telleth the number of the stars; He calleth them all by their names."

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XUM

The Sidereal Messenger.

Conducted by Wm. W. PAYNE, Director of Carleton College Observatory, Northfield, Minn.

"In the present small treatise I set forth some matters of interest to all observers of natural phenomena to look at and consider."—GALILEO, *Sidereus Nuncius*, 1610.

VOL. 4. NO. 2. MARCH, 1885. WHOLE NO. 32.

On the Distribution of the Stars in the Northern Hemisphere. By Prof. H. SEELIGER.

ABSTRACT.

As is well known, the *Durchmusterung* of ARGELANDER contains the position and magnitude of all stars visible in a 3-inch comet-seeker, with a power of 10, from the north pole to —2° declination. Prof. SCHOENFELD has completed a similar *Durchmusterung* from —2° to —23° which is not yet published. The stars of these lists are between the 1.0 and 9.5 magnitudes, (the last approximate only). In 1869, VON LITTROW had the stars of the northern D. M. counted by *magnitudes* and by *declination*. That is, he had the zones of 1° wide in decl. counted, so as to exhibit the number of stars of each tenth of a magnitude. Unfortunately he did not separate the stars so as to exhibit the numbers in right ascension also, as he might easily have done. Prof. SEELIGER, of Munich, has just completed a count of this kind. He was led to do this, he says, because there was no such count in existence, and one was needed. It is clear that a kind of astronomical "clearing-house," where accounts can be adjusted is also needed! A count of the kind exists in *ms.* at the Bonn observatory (see Bonn Obs. Vol. V), but is not accessible. The Washburn observatory

prints in its Vol. III, the beginning of a count of this kind (from $-2°$ to $+15°$), which was stopped on hearing of Prof. SEELIGER's. Prof. SEELIGER appears also to be unaware that LITTROW's count has been repeated by Mr. PEIRCE, (Annals H. C. O., Vol. IX)! With this digression, which is not uninstructive, we return to Prof. SEELIGER's important paper. He has then counted the stars of the D. M. accurately, and by R. A. as well as Dec. and mag. Instead of keeping magnitudes down to the tenths, he has wisely selected the following classes:

1,	containing	stars	from	1.0	to	6.5	mags. inclusive.
2,	"	"	"	6.6	"	7.0	" "
3,	"	"	"	7.1	"	7.5	" "
4,	"	"	"	7.6	"	8.0	" "
5,	"	"	"	8.1	"	8.5	" "
6,	"	"	"	8.6	"	9.0	" "
7,	"	"	"	9.1	"	9.5	" "

The number of stars for each 20^m of R. A. and each $1°$ of Dec. was counted. These numbers have been united into sums giving new numbers of stars in areas of 20^m in R. A. by $5°$ in Dec. The latter tables are to be printed by the Munich observatory.

Prof. SEELIGER's paper contains the number of stars for each area of 40^m in R. A. by $5°$ in Dec., the stars of each class 1 — 7 being enumerated separately. There are, in the northern sky, 4120 objects of class 1; 3887 class 2; 6054 class 3; 11168 class 4; 22898 class 5; 52852 class 6; 213973 class 7; 314952 in all, besides 126 nebulæ, variables, etc. That is 315078 in all, by Prof. SEELIGER's count. ARGELANDER gives 315089. To deal with this mass of figures, Prof. SEELIGER divides the sky into 8 zones. Zone 1 has its centre at the north pole of the Milky Way, and extends to Galactic Polar Distance $20°$; zone 2 extends from G. P. D. $20°$ to $40°$; zone 3, from $40°$ to $60°$; zone 4, from $60°$ to $80°$; zone 5 (containing the Milky Way itself) from $80°$ to $100°$, and so on to G. P. D. $140°$.

The number of stars (of each class) per zone is next determined; and next the number of stars (of each class) in

each 1° square. We may quote the figures for class 1 and classes 2–7 taken together:

	Class 1.	Classes 2–7.
Zone 1,	0.15	8.51
2,	0.15	8.95
3,	0.17	11.02
4,	0.21	16.77
5,	0.27	24.60
6,	0.25	18.92
7,	0.15	11.59
8,	0.12	10.19

This table shows the influence of the Milky Way most markedly; but if changed so that the number of stars in Zone 5 is always 1.00, it becomes even more interesting.

	Class 1.	Classes 2–7.
Zone 1,	0.55	0.35
2,	0.57	0.36
3,	0.64	0.45
4,	0.79	0.68
5,	1.00	1.00
6,	0.91	0.77
7,	0.57	0.47
8,	0.43	0.41

If we call these last numbers D, and if we form $\frac{7}{1-D}$, these numbers may be called the *gradients* (G), expressing the rapidity of increase of number of stars as we approach the milky way. The values of G are

Class 1,	0.36	Class 5,	0.44
2,	0.48	6,	0.45
3,	0.42	7,	0.45
4,	0.47	8,	0.52

Classes 2–7, 0.50.

It thus appears probable that G is greater for the fainter stars. but not so much greater as has been commonly supposed. For stars of the *mags.* 1, 2, 3, and of the *mags.* 4, 5, 6, G results 0.34 and 0.19. These numbers show an important difference between the bright and the faint stars. If we were allowed to assume that stars even fainter than 9.5 would continue to show the constant gradient that these show, it would follow that our stellar system was not to be considered as a flat disc, but rather more or less spherical,

with the stars concentrated near its medial plane (the Milky Way).

The author next proceeds to compute the center of gravity of each class of stars, and its position is,

			$\frac{(R)}{r}$
Class 2,	R. A. = 23h 30m	Dec. +79°.5	0.58
3,	22 32	+81 .5	0.58
4,	23 10	+79 .7	0.56
5,	23 7	+79 .3	0.53
6,	23 9	+78 .3	0.51
7,	24 14	+77 .3	0.51

The last column gives the ratio $\frac{R}{r}$ for each class; where R is the distance of the center of gravity of *all stars* of the class, r that of every star of that class.

The full interpretation of these numbers can only be made when SCHOENFELD'S D. M. is published. Certain further conclusions may also be drawn from the author's figures. This paper is the most important which has appeared on this very interesting question since the publication of Dr. GOULD'S *Uranometria Argentina*. E. S. H.

THE NEBULÆ.

[Concluded.]

The question of the absolute distances of the nebulæ and clusters has always excited a high degree of interest among astronomers, but it is impossible, within the limits to which I intend to confine myself, to discuss a subject which, from its very nature, is and must be purely speculative. That they are vastly more distant than the stars is undoubtedly true. In regard to the origin and design of these immense masses of matter, strewn with such lavish abundance in some regions and so sparsely scattered in others, we are also entirely ignorant. In volume they as greatly exceed that of the *Sun* as does the *Sun* that of the minutest microscopic atom. Before the invention of the spectroscope it was a favorite and somewhat plausible theory that all nebulæ were clusters of stars which might be resolved into such were we possessed of telescopes large and powerful enough. A partial success in this direction

made the theory very popular. But spectroscopic examination settled at once the vague conjectures of a century. It tells us in language too plain to be misunderstood or doubted, that some are clusters of stars, while others are masses of gas, or nebulous matter, whatever that may be. It would be natural to suppose that inasmuch as these gaseous bodies can be but little acted upon by others, they would, in obedience to the law of gravitation, have ages ago assumed a spherical form, which is quite true of the most of them, though many are as shapeless as the nimbus clouds, and as indeterminate as wreaths of smoke. Of this latter class the great nebula in *Orion* and the *Swan* nebula are notable examples. The most symmetrical of them have no points of reference from which to measure as have the stars and comets with nuclei; nor sharp outline of limb as have the *Sun*, *Moon* and planets, and consequently the question of distance cannot probably be settled until after the lapse of centuries as it is impossible to obtain with mathematical exactness the position of a nebula that has no starlike nucleus from which to measure.

Under the varying conditions of the atmosphere—its purity, steadiness and other causes—nebulæ with many intricate details will on different nights present very different aspects. A description, therefore, of one of these objects from a single observation will be often misleading and give rise to a suspicion of change when, in reality, no change has taken place. Some of Sir WILLIAM HERSCHEL'S descriptions of his nebulæ as recorded nearly a century ago are widely at variance with their present appearance. Take for example H. 493 III=General Catalogue 493, described by him as "very faint; small; round; bright in the middle; among stars." Almost exactly in its place I have found a nebula described as follows: pretty faint; very elongated; spindle; not a star nearer than 4′. D'ARREST has one near which was easily seen, though not in any respect answering the description of HERSCHEL. Again 741 III=G. C. 4328 is described by HERSCHEL as "very faint; very small; round; stellar;" while my account is, pretty

bright; exceedingly elongated. MESSIER's 76=G. C. 385 R. A. for 1885.0, $1^h\ 34^m\ 52^s$ Dec. $+50^\circ\ 58'\ 48''$ is recorded in the catalogues as double. Through the 4½-inch telescope it has always appeared square, but seen through the 16-inch instrument it becomes a right-angled parallelogram with size about as 1 to 2 and filled with nebulosity, but having two points of brightness it was called double by Sir WILLIAM HERSCHEL. On one exceptionally good night I observed it as a spiral, and, searching his record of observations, I found that Lord ROSSE had previously seen it as such. For one so small it is a remarkable object.

Another wonder and one which appears entirely unlike the illustrations made by Lord ROSSE, LASSELL, TROUVELOT and others, is the well known *Swan*, or *Omega*, or *Horse-shoe* nebula of the *Milky Way*, a region where very few nebulæ are found. It is No. 4403 of G. C. and 17 of MESSIER, and is in R. A. $18^h\ 14^m$; Dec. $-16^\circ\ 13'$ or, in the constellation of *Sobieskii's Shield*. The following sketch

is a rough illustration of it as seen on many occasions. It is drawn from memory and, of course, not to scale. The singular appendage at the following end has, as far as I know, never before been seen. It was first noticed on July 4, 1883, and entered in my note-book as follows: "Saw a curious appendage from the *f* end of the *Swan* nebula not represented in any known drawing, being an eF. nebulous band irregularly bright, curving gracefully upward (inverted field) then to the right and downward and to the

left, curving under the nebula proper and ending near a L. e. e. F. nebula. Cannot trace it clear to the new nebula." "July 5—The above observations are confirmed in every particular with the addition of other *nova* to the left of the neck, one which has, I believe, been previously seen." "July 6—The foregoing phenomena were well seen by Mr. WARNER and Mr. REBASZ. There is much of detail in it, and to accurately represent it requires drawing to scale." Subsequently upon the occasion of their visits to this observatory, it was seen as represented by Dr. COPELAND and Mr. TROUVELOT.

In R. A. $11^h\ 22^m\ 11^s$; Dec. $+59°\ 13'$ is G. C. 24 .5 = H 247 I, mentioned by all observers as very little elongated. Chancing to run across it with a power of 132, I immediately suspected it to be a close double, which suspicion a power of 200 confirmed. It is probably the closest double nebula known. I shall re-examine it at the first opportunity.

In 1859 while searching in *Eridanus* for comets I ran upon the most conspicuous nebulous star visible from this latitude—a 7th magnitude star nearly in the center of a bright nebulosity. As both were so bright I, of course, supposed they were well known. Not until five years since was I aware that this wonderful object was not in the G. C. In DREYER'S supplement to that catalogue there is, however, a nebula, G. C. 5315, discovered by WINNECKE, and agreeing very well in position, which he describes as "faint; 10′ long"—about as erroneous a description of it as could well be written. Prof. BARNARD, of the Vanderbilt University Observatory, Nashville, Tenn., from his greater southern position has, at my request, made a study of this interesting object, and in a recent letter gave me its position for 1885.0 as follows: R. A. $3^h\ 28^m\ 25^s$; Dec. $-26°\ 15'\ 47''$. Its position for the same epoch as given by WINNECKE is $3^h\ 28^m\ 40^s$; Dec. $26°\ 13'.4$. Being ignorant of the the date of WINNECKE'S observation, I am unable to decide to whom the honor of its discovery belongs.

On the night of April 26, 1884, while engaged in nebula-

seeking, there occurred to me the thought that perhaps there are undiscovered nebulæ in close proximity to some of the brighter stars. The telescope was turned upon *Delta Leonis*, and immediately there was seen a nebulous object which proved to be new, and which recorded in the vernacular of my note-book, reads: "C. S.; p. F.; R. f. *δ Leonis*; 4ˢ; 7′ −; easily overlooked." This in unabreviated language means, considerably small; pretty faint; round; follows *Delta Leonis*; 4 seconds of time, and is 7 minutes of an arc south of it.

Encouraged by this success, search close to many other bright stars was made but without avail, until Oct. 18, when one was found=to diameter of field (26′) from the variable star *Algol*. At the same time another, also a *nova*, was seen 2° 15′ farther south.

The greater part of HERSCHEL'S class III are bright objects compared with most of those discovered at this observatory. Nearly one-half of the 200 *novæ* can be seen only by averted vision and by the most persistent and long-continued effort. But few nights in a year are suitable for the finding of objects so extremely faint. I have never yet, from a wearied eye, been obliged to desist from comet seeking, though I have many times continued it during the entire night; but am often compelled to abandon nebula-seeking. When, in nebula work, the tired eye fails to equal its best effort, resort is had to the less fatiguing work of comet searching.

Nebulæ are often associated in pairs and sets, and so frequently has this been observed that on the discovery of one, search in its immediate vicinity is invariably made for a mate, and often as the result of chance, one is found apparently connected by physical relations like the binary system of double-stars.

The task of getting their positions quickly and to the desired degree of exactness is a difficult one. The plan adopted may not be the best; in fact I feel quite certain that with more experience and the exercise of greater vigilance, I shall be able to improve my methods. Nearly all

of the undiscovered nebulæ are exceedingly faint. Though the reapers who have preceded us were few they labored hard and resolutely, and heeded not the advice of Boaz to let fall some handfuls for the gleaners who were to follow after. The dome-room is absolutely dark while I am sweeping, and the pupil of the eye is greatly expanded (an essential preparation for the observation of such faint bodies.) The gas is lighted only while reading circles and making records, but, as after its extinguishment, I am for a few minutes, nebula-blind, a considerable loss of precious time is involved.

The eye-piece used for this work is a periscopic positive. I have never yet seen a negative eye-piece suitable for comet or nebula seeking, especially the latter. The field of the negative eye-piece is made luminous by the rays from the object-glass impinging upon the field lens, which is not the case with a positive, where the rays come to a focus before reaching it. In front of, and at a proper distance from, the field-lens of the eye-piece used are inserted in a ring, two coarse hairs in the form of a cross, the intersection being exactly in the line of collimation. With little effort and without artificial illumination they can at all times be seen, while never save in presence of moonlight are they obtrusive. When a nebula is found, it is brought roughly to the center of the field, the driving-clock started, the telescope clamped in R. A., the optical center of the nebula bisected with the wires in both coordinates, the telegraph sounder connected with the break circuit sidereal clock started; all without removing my eye from the telescope and without an assistant. After noting its size, shape, brightness and configuration with some of the nearer stars in the field, and if excessively faint, and therefore probably to be re-found with difficulty, the number of seconds as counted from the sounder by which it follows or precedes the nearest bright star. I then descend from the observing-chair read the circles, make the records, both as to position and appearance. As I always, except in special cases, work on or very near the meridian, their posi-

tions in R. A. are therefore corrected only for precession, and in Dec., for both precession and refraction. Every nebula thus picked up except those that are bright and therefore presumably not new are noted down in the working-book. The next day every known catalogue of nebulae is examined, and if any in my list are identical with any in the catalogues, record is made in a special ledger. The new ones are carefully reduced and recorded in another ledger ready for publication.

The discovery of nebulæ and the getting of their approximate places is one thing, while the obtaining of their micrometrical positions with mathematical exactness, is another and a very different matter. For the former work (their discovery) one set of appliances only can be used, viz; an eye-piece of low power and a large field for sweeping. For the latter quite another plan must be adopted, and the two cannot be combined. A micrometer eye-piece is as poorly adapted to nebula as to comet seeking. In view of the small number of hours in a year suitable for successful search for such faint objects, but slow progress would be made were the observer compelled to exchange his comet eye-piece for a micrometer and to lose much valuable time in refinding the object—which probably could not be seen at all—selecting his comparison-stars, getting its place and angle of position, determining the direction of its major axis if elliptical, and various other data. To accomplish all this and make his records would require his lamp to be several times lighted, and this, on each occasion, would blot out the nebula, often of unimagined faintness. Then how great his disappointment after all his loss of time to find, as he very probably would, that his presumed new discovery was perhaps a century old.

I see, therefore, no way but to pursue the plan already detailed, viz; to get positions with all the accuracy possible *with the means adopted for their discovery*, leaving to specialists to pick them up without sweeping and to fix their places with such exactness that those who come after us may be able to determine whether they also like the

stars, are drifting. It may be that they are no farther distant than the stars, and, consequently, their proper motion may be equally great, and ought, therefore, at least in some cases, to be detected in the course of a century or two.

The faintness of a majority of those in my list of *novæ* is inconceivable except to those who are engaged in similar work. With a luminous field, the largest telescope in the world would not reveal one of them, and it is very doubtful if, even with a dark field and luminous wires, micrometrical measures of position can ever be successfully made.

LEWIS SWIFT.

WARNER OBSERVATORY, Feb. 12, 1885.

Second Report of the Committee on Standards of Stellar Magnitudes.

The first report of this committee (*Proc. Amer. Assoc.* XXX, p. 1) included a plan for the determination of standards for stars fainter than the tenth magnitude. Twenty-four bright equatorial stars were chosen and the standards were to be selected from the regions following them from two to six minutes of time and not differing in declination from the leading stars by more than five minutes of arc. The observations described below have been made at the Harvard College Observatory unless otherwise stated. The light of each of the leading stars has been determined on from seven to eighteen nights with the meridian photometer. Charts have been constructed of all the stars visible with the fifteen-inch telescope, in all but three of the regions from which the standards are to be selected. Most of these charts have been submitted to a careful scrutiny with the fifteen-inch telescope of the Washburn Observatory. An important test of the completeness of the charts is thus afforded.

In the following table three successive columns give the names of the twenty-four leading stars and their approximate right ascensions and declinations for 1880. The next two columns give the number of nights on which they were observed with the meridian photometer, and the resulting magnitude. The details of these measures and a compari-

son with various other determinations of their light will be found in the *Harv. Observ. Annals*, Vol. XIV. The last columns give the number of stars in each of the charts, and the corresponding number of stars contained in the same portions of the Durchmusterung.

Stars suitable for standards must next be selected by the help of the charts. The light of these stars should then be measured in as many different ways as possible. The committee will be much indebted for aid that may be rendered them in this portion of their work. The early publication of the charts now becomes a matter of importance, as it would permit their immediate use for various purposes.

Names.	R. A. 1880.		Dec. 1880.		No. Nights.	Phot. Mag.	Stars on Chart.	D. M. Stars.
	h.	*m.*						
γ Pegasi	0	7.1	+14°	31′	13	3.04	49	3
θ' Ceti	1	18.0	− 8	48	12	3.77	27	—
α Piscium	1	55.9	+ 2	11	12	3.99	—	1
α Ceti	2	56.0	+ 3	37	11	2.68	—	2
γ Eridani	3	52.4	−13	51	10	3.05	30	—
α Tauri	4	29.0	+16	16	16	1.00	19	3
ε Orionis	5	30.1	− 1	17	16	1.76	42	6
γ Geminorum	6	30.8	+16	30	17	2.00	150	5
α Canis Minoris	7	33.0	+ 5	32	15	0.46	96	3
ε Hydrae	8	40.4	+ 6	51	7	3.58	64	4
α Leonis	10	2.0	+12	33	15	1.42	39	1
θ Leonis	11	7.9	+16	5	10	3.47	24	3
η Virginis	12	13.8	+ 0	0	10	4.05	23	2
α Virginis	13	18 9	−10	32	13	1.23	30	—
α Bootis	14	10.2	+19	48	13	0.03	25	1
β Libræ	15	10.5	− 8	56	14	2.74	39	—
δ Ophiuchi	16	8.1	− 3	23	11	2.77	48	—
η Ophiuchi	17	3.5	−15	34	10	2.62	100	—
η Serpentis	18	15.1	− 2	56	10	3.35	7	—
δ Aquilæ	19	19.4	+ 2	53	14	3.46	—	3
θ Aquilæ	20	5.1	− 1	11	10	3.39	110	2
β Aquarii	21	25 2	− 6	6	10	3.14	52	—
α Aquarii	21	59.6	− 0	54	10	3.16	48	0
α Pegasi	22	58.8	+14	34	18	2.61	29	3

Respectfully submitted,

Edward C. Pickering, Chairman.

Lewis Boss, S. W. Burnham,
Asaph Hall, Willian Harkness,
Edward S. Holden, Simon Newcomb,
C. H. F. Peters, Ormond Stone,
C. A. Young.

Index to the (54) Published Ecliptic Charts of the Paris Observatory.

No.	R. A.				Decl.			
1	0^h	0^m to	0^h	20^m	+ 1°	0′ to	− 4°	15′
1ª	0	0	0	20	+ 1	0	+ 6	15
2	0	20	0	40	− 1	45	+ 3	30
2bis	0	20	0	40	+ 3	30	+ 8	45
3	0	40	0	60	+ 6	15	+ 5	30
3ª	0	40	1	0	+ 6	30	+10	45
4	1	0	1	20	+ 4	45	+10	0
5	1	20	1	40	+ 7	0	+12	15
6	1	40	2	0	+ 9	0	+14	15
7	2	0	2	20	+10	30	+15	45
8	2	20	2	40	+12	15	+17	30
9	2	40	3	0	+14	0	+19	15
10	3	0	3	20	+15	15	+20	30
10ª	3	0	3	20	+10	0	+15	15
13	4	0	4	20	+18	45	+24	0
15	4	40	5	0	+20	0	+25	15
22	7	0	7	20	+20	0	+25	15
26	8	20	8	40	+16	15	+21	30
27	8	40	9	0	+15	0	+20	15
28	9	0	9	20	+13	45	+19	0
29	9	20	9	40	+12	15	+17	30
29	9	20	9	40	+ 7	0	+12	15
30	9	40	10	0	+10	30	+15	45
31	10	0	10	20	+ 8	45	+14	0
32	10	20	10	40	+ 6	45	+12	0
33	10	40	11	0	+ 4	45	+10	0
34	11	0	11	20	+ 2	45	+ 8	0
35	11	20	11	40	+ 0	30	+ 5	45
36	11	40	12	0	− 1	30	+ 3	45
38	12	20	12	40	− 5	45	− 0	30
39	12	40	13	0	+ 8	0	− 2	45
40	13	0	13	20	−10	30	− 5	15
41	13	20	13	40	−12	0	− 6	45
43	14	0	14	20	−15	44	−10	30
43ª	14	0	14	20	−10	30	− 5	15
46	15	0	15	20	−20	30	−15	15
48	15	40	16	0	−22	45	−17	30
49	16	0	16	20	−23	45	−18	30
50	16	20	16	40	−24	30	−19	15
51	16	40	17	0	−25	0	−19	45
52	17	0	17	20	−25	30	−20	15
59	19	20	19	40	−24	30	−19	15
60	19	40	20	0	−23	45	−18	30
61	20	0	20	20	−22	45	−17	30
62	20	20	20	40	−21	30	−16	15
63	20	40	21	0	−20	15	−15	0
64	21	0	21	20	−22	0	−16	45
64ª	21	0	21	20	−16	45	−11	30
67	22	0	22	20	−14	0	−10	45
68	22	20	22	40	−12	15	− 7	0

No.	R. A.		Decl.	
69	22 40	23 0	−10 0	− 4 45
70	23 0	23 20	− 8 0	− 2 45
71	23 20	23 40	− 5 45	− 0 30
72	23 40	24 0	− 3 45	+ 1 30

E. S. H.

THE LICK OBSERVATORY.

THE EDITOR.

The February number of *Harpers' Monthly* contains an article from the pen of Professor S. NEWCOMB concerning the beginning and growth of the Lick Astronomical Observatory at Mount Hamilton, California. Of the personal character of Mr. LICK, and the charming view of the surrounding country from the mountain summit considerable is said in interesting detail. The pen-picture of the eccentric and wealthy Californian, to which the reader is introduced appears in rough outline, and lively contrast with the other sketch from nature which is grand in its simplicity and beauty.

The outline of the site for an astronomical observatory, in a measure, is assured by the continuous and successful observations of double-stars taken by S. W. BURNHAM, of Chicago, who was at Mount Hamilton for several months in 1879 for the purpose of determining the advantages of that place for astronomical observation. In 1882 Prof. D. P. TODD, of Amherst, made observations and photographs of the transit of *Venus* at the same place, and the photographs are said to be the finest that ever have been taken of a transit of *Venus*.

In 1880 the trustees of the Lick Observatory contracted with Messrs. ALVAN CLARK & Sons to make an object-glass of thirty-six inches clear aperture for the great telescope. The difficulty and hazard of such an undertaking on the part of the makers are poorly realized by our readers if only the fact be stated that such a refracting objective (if

it could be made at all) would have a diameter six inches greater than any other ever attempted by any maker. The casting of the two rough disks for so large an objective, that should be perfectly clear and of uniform density, was a task so difficult in itself that scarcely more than one responsible glass foundery in the world would undertake it. FEIL, of Paris, has contracted to furnish these disks and found little trouble in making the flint-glass disk, which has already been in the hands of the optician for about two years, and which is apparently a beautiful specimen of the French art as the writer would say from a casual look at it. The crown-glass disk, which has proved so far too much for the skill of FEILS, is by no means given up. The elder member of the firm has been absent from the works for some time, and it has been thought by some who have had opportunity to know that the nineteen or more failures that have occured in attempting to cast this disk may have been due, in part at least, to the want of his superior skill. Recently the elder FEIL has resumed charge of the foundery and a pair of crown disks have been cast that it is hoped may be successfully annealed. If this step proves successful the grinding of the glass can then go forward; but this part of the work will consume at least two years and more likely twice that time. Then will follow the mounting, which is a problem scarcely less serious or intricate than others already named.

From the pen of Prof. E. S. HOLDEN we have already given in the MESSENGER a very full and interesting account of the fine Meridian Circle recently made by the REPSOLDS, of Hamburg, Germany, under the direction of Professor HOLDEN, who also personally superintended its mounting in the observatory only a few months ago.

Respecting other points of general interest about this great observatory, the *Morning Call* (San Francisco, Cal., Feb. 8) has the following: "The work of constructing the great dome, 75 feet high, to cover the telescope, which will be nearly 60 feet long, goes on. During the winter, the foundation of solid rock, 72 feet in diameter and 6 feet deep,

will be excavated. The material of the dome will be of brick and iron, and the construction will probably be commenced in June. Already 400,000 bricks have been hauled to a point within two miles of the observatory. Next to the discovery of a glass founder capable of supplying the necessary lenses for the great telescope, the Lick trustees have met with the greatest difficulty in devising an efficient system of water-works. That trouble has, however, been overcome, and a complete system of water-works is now in operation. Water is obtained at a distance of 400 feet below the observatory and pumped up by steam to a reservoir 50 feet above the observatory, and having a capacity of 100,000 gallons. A supply of rain water at a gap lower down suffices for the stables and other habitations there situated. Seventy thousand gallons were thus obtained during the last heavy rainstorm. According to the rain-gauge at the observatory the rainfall up to February 1st had reached the high figure of 41½ inches. The trustees have expended on the work done so far $280,000, of which $12,000 has been paid on the glass for the great telescope. The entire cost of the glass will be $50,000. The mounting of the telescope will entail an expenditure of $50,000 more, as an instrument so prodigious requires machinery of an unusually complicated quality to operate it. In observations an astronomer sees but a tenth of the apparent size of the planets, and can observe nothing of the other heavenly bodies. The machinery which moves the telescope must, therefore, be of the nicest exactness, as by its movements the astronomer locates the almost endless subdivisions of the sidereal world. When the south dome is finished and the observatory ready to be transferred to the State it will have cost about $425,000. The establishment has already won an enviable reputation by the astronomical work done there during the recent transit of *Venus*. The government sent its astronomers to places only where the entire transit was visible, and the Lick Observatory had to engage some scientific gentlemen for the occasion at its own expense. Professor TODD, one of these gentle-

men, succeeded in taking some photographs of the transit which have been universally declared by the scientific world the finest ever seen. The conditions under which the photographs were taken were perfect, the day being such as is rarely seen except in California, and the appliances at the observatory ample. The remarkable success of the first important piece of work attempted by the observatory strengthens the opinion of the scientific that the Mount Hamilton establishment will contribute largely to the astronomical knowledge of the age. One year on the summit of the California mountains affords the opportunities which twelve years of observations in the changeable climates of other states do not furnish. Professor NEWCOMB in his able article admits this fact."

HINTS TO OBSERVERS OF SATURN.

B. J. HOPKINS.

Fifteen years hence is a long time to look forward to, however short a period it may seem to look back upon; and as it will be all those years before the system of rings round the planet *Saturn* are again placed in such a favorable position for observing the markings upon their surface as they are at the present opposition, those astronomers possessing telescopes of adequate power cannot do better than take full advantage of their present opportunity.

As Mr. DENNING points out in the very interesting article on this planet, on page 265, in Vol. XXII, of this journal, we have very "little information as to the changes which probably effect the detailed appearance of the planet in different years;" therefore, good useful work may be done by those astronomers possessing efficient instrumental power making *careful* and accurate drawings, and micrometer measures of the different markings they may observe upon the planet's surface; keeping a good lookout for anything in the shape of spots as they are likely to give the clue to the nature of the planet's surface. The breadth

and color of all belts should be carefully noted, together with the shape of any spot that may be observed, as they are probably subject to changes of a more sudden nature than the similar markings on *Jupiter*, though a longer interval intervenes between successive changes on this planet than on the surface of the latter.

With reference to the markings on *Saturn*, the narrow belt described by Mr. RANYARD, in Vol. XLIV., page 441 of the *Monthly Notices*, is worth attention, as it appears to have become more conspicuous than it was at the last opposition.

Another point, too, which deserves much more attention than has hitherto been given to it, is the shadow of the ball on the rings. This shadow is worthy of careful telescopic study, because it does not present at all times those uniform outlines which the laws of perspective teach us should be presented by the shadow of a spheroid projected upon a plane surface; but very frequently this outline is curiously distorted. Observing the planet on the evening of December 5th, 1884, with an 18-inch silver-on-glass reflector and a power of 1,000, the outline of the shadow on the rings was in the form of a truncated cone, as shown in an engraving forming the frontispiece to the *Register*. This distortion of the shadow on the rings is probably due to the unevenness of the surface of the rings, which is sometimes so considerable as to cause the shadows of the rings on the ball to have a notched appearance, as has been observed by LASSELLS, DE LA RUE, JACOB, and others.

Careful watch should be kept for the occultation of any star by the rings, which it is needless to add is a very rare phenomenon, DAWES being the only astronomer who, so far as is known, has had the good fortune to observe a star pass behind the rings. In such a case it should be noted if the star was visible through CASSINI'S division or not; it probably would be, but it is uncertain, as it is possible that CASSINI'S division is filled with a similar material to that of which the dark ring is composed, and a faint star might

be so dimmed as to be invisible. As that careful observer, JACOB, once followed the shadow of the ball across this division, the present time would be very favorable for settling the question, as to whether it is absolutely black or not. While some observers have seen it not quite black, the writer has never been able to observe it of any other color; but large apertures are requisite to solve the question. —*Astronomical Register.*

Leyton, Essex.

THE SUN'S CHROMOSPHERE.

S. J. PERRY.

An automatic spectroscope by BROWNING is employed for these daily measures of the chromosphere, and during the year 1884 the same dispersion, viz., 6 prisms of 60°, has been invariably used. The greater part of the year has been very favorable for these observations, and the increase in the results is well marked in the first column of figures. The mean height of the chromosphere, which differed little in 1882 and 1883, and attained its maximum in May, 1883, has fallen away rapidly this year. This is partly due to the continuance of very low readings throughout August and September, but it remained to the end of the year considerably below the average of the three preceding years. There is also a great diminution in the numbers of the prominences and some falling off in their average height. The low reading 6″.41 for the chromosphere on June 30 was the more remarkable, as the prominences were numerous, and the highest recorded for the month was observed that day.

The number of observed displacements of the C line differed but little in the last two years, but the amount of displacement was slight in 1884 compared with that seen in 1883. The distortions recorded during the months of April and May, 1882, were far greater than any observed during the last two years. The line K 654·3 was seen on five different days as a bright line in the chromosphere,

C being on each occasion very bright, but short. Both lines were about the same height, but their intensities were as three to ten.

	No. of day. of obs. per month.	Mean height of chromosphere excluding prominences.	Mean height of prominences.	Mean extent of prominence arc.	Highest prominences.	No. of days on which lines were observed distorted.
		"	"	° ′ ″	′ ″	
Jan.	1	8·11	21·35	11 13 0	0 40·99	0
Feb.	5	8·37	27.16	44 53 24	1 1·92	3
March.	2	7·69	23·91	29 21 0	1 21·13	1
April.	7	8·36	28·67	43 31 51	1 34·79	2
May.	13	8·44	27·52	48 10 46	1 35·22	4
June.	14	8·36	23·61	36 48 21	1 19·00	2
July.	4	8·11	22·74	31 14 15	0 52·52	0
Aug.	13	7·10	25·42	34 6 42	1 25·40	4
Sept.	9	7·26	23·87	20 53 40	0 59.78	2
Oct.	6	7·83	29·89	17 26 10	1 3·20	1
Nov	7	7·93	28·78	14 31 26	2 2.12	2
Dec.	7	7·75	25·92	17 1 26	0 55·51	3
1880.	5·3	7·93	23·46	23 21 23	1 7·40	..
1881.	4·3	8·04	24·61	33 18 26	1 11·93	..
1882.	5·8	8·24	24·55	40 56 47	1 14·10	2·8
1883.	6·1	8·27	27·23	41 24 15	1 35·43	1·9
1884.	7·3	7·94	25·74	29 6 0	1 14·30	2·0

Stonyhurst Observatory, —*Observatory.*
Jan. 16, 1885.

EDITORIAL NOTES.

Number two of this volume of the MESSENGER is published for March instead of February on account of unexpected and prolonged absence recently from the state.

We should have mentioned before that Dr. B. A. GOULD'S astronomical work at Cordova, South America, would be completed some time last month In December last, the General Catalogue of stars was far advanced in copying for the press. It contains approximately 43,000 positions of about 35,000 southern stars. This catalogue completes the work for which Dr. GOULD went to Cordova in 1879. His address at present is Wollaston, Massachusetts.

The Great Nebula of *Orion* was discovered by CYRAT, of Luzene, in 1618, as stated in the "Monograph of the central parts of the nebula of *Orion*" by Professor E. S. HOLDEN, (see page 16 of the appendix to Washington observations, 1878.) H. C. W.

ALGOL.

Minima of *Algol* (β Persei) for February and March, 1885, in 75° mean time, computed from a minimum given in the *Observatory* for January.

February....	3d	7h	35m
February....	17	15	39
February....	20	12	28
February....	23	9	17
February ..	26	6	6
March.....	12	14	11
March	15	11	0
March.....	18	7	49

ARTHUR C. PERRY.

NEW NEBULÆ IN ERIDANUS.

I have found in my comet sweeps with 5-inch Byrne refractor the following new nebulæ:

$$\left.\begin{array}{rl} a= & 3^h\ 14^m\ 34^s \\ \delta= & -\ 19°\ 32'\ 53'' \end{array}\right\} 1885.0$$

Faint, not large. From one corrected equatorial pointing.

$$\left.\begin{array}{rl} a= & 3^h\ 14^m\ 58^s \\ \delta= & -\ 26°\ 29'\ 6'' \end{array}\right\} 1885.0$$

c F; S; R; p s v m b M; $1\frac{1}{4}'$ *s. f.* 9m star.

From one corrected equatorial pointing.

I have also found a large, distinct nebula 20″ *s. f.*, the first of the two nebulæ above. From a careful estimation with the finder, made in August, 1882, I deduce the following place of this last object:

$$\left.\begin{array}{rl} a= & 3^h\ 13.^m9 \\ \delta= & -\ 19°\ 53.'3 \end{array}\right\} 1885.0$$

I have taken this object to be No. 689 of HERSCHEL's General Catalogue. But bringing the place of 689 up from 1860.0, we have:

$$\left.\begin{array}{rl} a= & 3^h\ 14^m\ 30^s \\ \delta= & -\ 20°\ 49'\ 37'' \end{array}\right\} 1885.0$$

If the object seen by me is 689 the place in General Catalogue is erroneous. It will be noticed that my approximate place with finder makes this object really precede the first nebula in this list, while it actually follows it as stated. A slight error may exist in the pointing on the first nebula, as it was observed with difficulty on account of the sky rapidly clouding. No sky has since offered an opportunity for verification.

Vanderbilt University Observatory,
Nashville, Tenn., Jan. 16, 1885.

E. E. BARNARD.

ENCKE'S COMET.

I picked up ENCKE's comet on the evening of January 4, about 7 o'clock, very near the place indicated by the ephemeris. It was located in the head of *Pisce Occidentalis* just north of the star *Beta*.

It was quite faint, irregular in outline, slightly elongated in a north and south direction and with very small central condensation.

Red House Observatory, Jan. 20, 1885. WILLIAM R. BROOKS.

CHANGE IN THE ASTRONOMICAL DATE.

After consultation with the principal astronomers throughout the country, it has been decided that this observatory will make no change in the beginning of the astronomical date, the weight of opinion being that it will be better to defer such a change until the ephemerides are constructed in accordance with the recommendation of the recent International Meridian Conference.

U. S. Naval Observatory, Washington, Dec. 31, 1884. Very respectfully, S. R. FRANKLIN, Commodore, Superintendent.

Facing slightly west of south, early in the evenings of this month, a person unaccustomed to observing the stars cannot fail to see the beautiful constellation, *Orion*, about half-way from the horizon to the zenith. The two brightest stars in *Orion* are *Betelguese*, highest up to the left of a reddish color, and *Rigel*, a white star low down at the right. Midway between these two, are *three* in a line forming *Orion's* belt which point in a northwesterly direction about 22° to *Aldebaran*, the brightest star in *Taurus*, and in the opposite direction about the same distance to *Sirius*, (the Dog-star) the brightest in the heavens.

A line through the stars in the belt measures 3°, forming a good standard of measurment for ascertaining the distance between stars or other heavenly bodies. We can thus see that the *Moon* appears to cover more space in the sky than she really does; as, were she to pass between two of these stars, her diameter would subtend but about one-third the angle separating them.

The three faint stars below the belt, from *Orion's* sword; a person with good eyesight will notice that the middle one of these three has a hazy appearance, caused by the light of the "great nebula of *Orion*." With telescopic aid we see a dark opening in this bright nebula in which this ill-defined star is located. If we point a small telescope at this star, we see instead of one, four stars *very close together*, and, large telescopes reveal six.

There are hundreds of instances in the heavens where powerful telescopes show two stars, when but one appears as seen with the naked eye or a small telescope. Quite a number of these "doubles" are knowm to revolve around their common center of gravity, and are called binary systems, to distinguish them from those not known to be other than optically double. *Sirius* is one of the most remarkable of the binary class, making a revolution in about fifty years; its

companion is visible only in the largest telescopes, as it is very faint, and now less than 8″ from *Sirius*; this distance will diminish for several years to come, until but about 2″ will separate them. A. C. P.

PROPER MOTION OF A O e (2) 15647.

This star has proper motions of −0.″021, −0.″45 approximately, or more than 0.″5 in a great circle. E. S. HOLDEN.

SOUTH AMERICAN LONGITUDES.

Measurements of differences of telegraphic longitude in South America have been completed by the parties of the U. S. Hydrographic office, under Captains GREEN and DAVIS. The sum of the errors of longitude in the polygon, Greenwich, Washington, Havana, Panama, Valparaiso, Cordova, Buenos Ayres, Rio, Lisbon, Greenwich is only 0.″18. E. S. H.

ORBITS OF METEORS.

The following orbits I have computed from radiant points deduced by Messrs. W. F. Denning and E. F. Sawyer from their observations of shooting stars. The observations of the former, from which the radiants were taken, will be found in Mon. Nat. R. A. S., Vol. XLII No. 2, page 85, and those of the latter in *American Journal of Science*, Vol. XVII, June number.

Current No.	Catalogue and No.	Long'tude of Perihilion.	Longitude of Node.	Inclination.	Perihelion Distance.	Motion.
1	Denning No. 1	265°.9	129.0	77.4	0.865	Direct.
2	" " 4	291 .0	129.0	85.7	0.976	"
3	" " 9	299 .2	123.3	64.2	0.999	Retrograde.
4	" " 11	300 .	126.	34.	0.997	"
5	" " 14	215 .5	128.5	17.5	0.474	"
6	" " 15	308 .5	127.0	49.0	1.000	"
7	" " 16	326 .0	121.4	79.3	0.955	"
8	" " 17	305 .9	126.2	26.4	1.000	"
9	" " 18	22 .0	128.5	81.7	0.642	"
10	" " 19	46 .0	126.2	80.0	0.415	Direct.
11	Sawyer No. 16	140 .5	188.2	16.6	0.163	"
12	" " 17	100 .3	185.7	20.6	0.460	"
13	" " 20	129 .8	206.5	28.1	0.385	"
14	" " 22	115 .9	211.5	7.7	0.549	"
15	" " 27	170 .7	243.1	37.2	0.349	"

The orbit computed from Sawyer radiant No. 22 bears a close resemblance to that of the comet of 1757, and indicates their probable identity.

Harvard College Observatory, Jan. 16, 1885. O. C. WENDELL.

DISTRIBUTION OF THE STARS.

From the pen of Mr. PROCTOR, in late numbers of *Knowledge*, profitable things are given concerning needed star-surveys. The problems of stellar distribution have always been attractive to astronomers from the times of the early masters to the present. Very different methods of study have been pursued by different scholars. Our readers will be interested in what Mr. PROCTOR says of his own. After projecting 324,198 stars—each one in its proper place on an equal surface projection, so that equal spaces in the heavens would occupy equal spaces on the map, he says:

"In the first place, I note a peculiarity in the large chart of 324,198 stars, which attracts attention at once, yet it is manifestly accidental, or due, rather, to the method in which the original series of 40 charts, and the single chart itself, were formed. The peculiarity is a defect, though of little importance,—yet interesting as illustrating the points which have to be attended to in such work. The circular chart seems to show in places multitudes of concentric streaks produced by the aggregation of stars along certain very narrow zones, concentric with the boundary of the map,—that is to say,having the north pole of the heavens as their center. As my friend Professor YOUNG pointed out, there cannot conceivably be any real tendency in the stars to form circular zones around the pole as center, along declination parallels; yet such a tendency seems manifestly suggested by the appearance of the great chart when closely studied. So far as the broad results sought and obtained are concerned, this peculiarity is of no more weight than the direction of the linear streaks by which in an engraving effects of light and shade are produced. Still until, or unless, the peculiarity is explained, it detracts something from the confidence with which those broader results are accepted.

Not really existing in the heavens, how does this peculiarity of star-distribution come to appear in the chart? The answer, though not at a first view obvious, is simple enough. The wonder would be if the peculiarity had not shown itself. ARGELANDER and his assistants, in their survey of the northern heavens, swept the skies in circles round the north pole, after the manner of survey with the equatorial telescope, which works in that sort (its main axis being directed polewards). Now herein is at once a possible cause, circular striation in the resulting charts, from the circumstance that one sweep might be made when the air was exceptionally clear, when moonlight was wanting, and other conditions for showing faint stars favorable (among other causes, difference of observing power among the six who took part in the work must be taken into account), while the next sweep might be made under conditions unfavorable for the work. This, however, is only a possible cause of circular striation,

though in so long a series of observations it must inevitably have occurred at times, and so had certainly a share in producing the peculiarity in question. But there was also a sure and certain cause of striation. The field of view of a telescope is a circle, and in sweeping the center of one field runs along a center arc, while the next field is taken a certain distance south of that arc (or north of it, according to the way the observer works). Say the field is half a degree in diameter, and the change north or south for successive sweeps nearly as great of a degree, so that one field only overlaps by a little the field next north or south of it. Then it is clear that the chance of discerning a faint star near the course along which the center of the field sweeps is much greater than the chance of discerning a star where the fields overlap; for in one case a whole diameter of the field is available for search, in the other only part of the arc. In sweeping, the star will not escape in one case if it be seen at any part of the comparatively long time during which that diameter is passing; but in the other case, if it be not caught while the short arc is passing it will not be caught at all. Thus, it is absolutely certain that fewer stars will escape along or near the tracks of the centers of the sweeping fields than midway or nearly midway, between the tracks of the centers. A concentric circular striation must necessarily result. To this must be added the probability that, however carefully I marked in my ninety-two circles there may have been slight departures from their true positions, whereby some of the zones were made slightly wider or slightly narrower than they should have been. This would make the striation more marked in some places and less marked in others than it would otherwise have been, but, on the whole, would help to make it coarser, and therefore more obvious."

The conclusion of Dr. SWIFT's interesting article giving the results of recent study of the nebulæ appears elsewhere in this number. It is due to the writer to say that the cut fails to give the true telescopic appearance of the *Swan* nebula; for example, the nebulous patch just below the extremity of the right hand arch is comparatively too bright. It should have been exceedingly faint, for it is a difficult object in the 16-inch refractor of the Warner Observatory. This was not Dr. SWIFT's fault wholly, for the drawing, though a hurried sketch, was fairly faithful.

"GEGENSCHIEN."

On the night of February 6, between 10^h and 11^h, there was seen a large, hazy "Gegenschien" extended along the Zodiac, on a line between *Jupiter* and *Praesepe*, slightly over one-third of the distance from *Praesepe*.

RING MICROMETER OBSERVATIONS OF COMET WOLF MADE AT THE SAYRE OBSERVATORY OF LEHIGH UNIVERSITY,

1884	Bethlehem Mean Time.			Apparent Geocentric. AR			Apparent Geocentric. δ			No. of Comparisons.	Star.	Star.	Mean AR 1884.			Reduction to Apparent.	Mean δ 1884.			Reduction to Apparent.	Authority.
	h	*m*	*s*	*h*	*m*	*s*	°	′	″				*h*	*m*	*s*	*s*	°	′	″	″	
Sept. 25	9	13	36.0	21	18	6.40	20	4	39.2	7	a	a	21	21	17.98	3.38	20	12	43.3	30.1	Weisse, XXI 473.
" 26	10	34	20.1	21	18	48.06	19	35	5.9	7	b	b									*American Ephemeris.*
Oct. 9	7	28	4.2	21	31	32.72	13	20	44.7	7	c	c	21	32	55.46	3.27	13	9	45.1	29.8	Weisse, XXI 751.
" 10	7	58	29.0	21	32	51.54	12	50	19.7	7	d	d	21	35	45.60	3.28	12	53	38.5	29.8	Weisse, XXI 824.
" 13	7	24	48.0	21	36	59.56	11	23	8.7	7	e	e	21	35	34.73	3.24	11	6	55.6	29.5	Weisse, XXI 821.
" 14	7	52	26.0	21	38	28.71	10	53	36.8	5	f	f	21	36	45.27	3.24	10	58	56.9	29.4	Weisse, XXI 856.
" 18	9	9	15.0	21	44	49.91	8	57	57.2	5	g	g	21	40	37.37	3.18	8	48	28.6	28.8	Weisse, XXI 946.
" 19	9	3	0.8	21	46	29.27	8	30	12.2	7	h	h	21	45	59.17	3.20	8	30	0.1	28.8	Weisse, XXI 1052.
" 20	8	13	48.1	21	48	6.26	8	2	55.6	7	i	i	21	48	51.27	3.20	8	14	44.4	28.8	Weisse, XXI 1114.
Nov. 8	7	45	45.8	21	26	23.65	0	27	39.6	7	k	k	22	26	45.52	3.17	0	30	25.1	26.0	Harvard Zones.
" 8	7	45	45.8	21	26	23.65	0	27	43.9	7	l	l	22	27	45.48	3.18	0	35	43.4	26.1	Weisse XXII 546 and Harv. Zones
" 10	7	24	33.3	22	31	17.14	−0	10	11.4	7	m	m	22	29	0 38	3.16	0	0	2.3	25.7	Weisse, XXII 574.
" 12	7	26	9.6	22	35	35.80	−0	46	57.8	7	n	n	22	36	46.24	3.17	− 0	32	6.2	25.3	Weisse, XXII 749.
" 14	6	59	55.7	22	40	15.38	−1	21	2.7	7	o	o	22	39	1.27	3.14	− 1	20	32.9	24.9	Weisse, XXII 793.
" 15	7	52	18.0	22	42	44.12	−1	38	14.6	7	p	p	22	39	51.78	3.13	− 1	32	35.5	24.7	Weisse, XXII 812.

The observations of September 25 and 26 were published in the MESSENGER of November, 1884. The computation has been revised and some small corrections applied which were neglected in the first reduction.

Bethlehem, Pennsylvania.

C. L. DOOLITTLE.

OBSERVATIONS OF COMET WOLF.

Made at the U. S. Naval Observatory, with the 9.6-inch Equatorial by Commander Wm. T. Sampson and Prof. E. Frisby. Communicated by the Superintendent, Commodore S. R. Franklin.

Date	*Wash. M. T.	—— * ΔJ	Δα	Δδ	No. of Com.	α app.	log (ρ × Δ)	δ app.	log (ρ × Δ)	Obs'r	Com. Star.
1884.0	h m s	m s	′ ″	″		h m s		° ′ ″			
Sept. 21	9 31 9	−1 14.61	− 0 19.9	20.4	21	15 53.70	8.651	+21 52 33.3	0.410	S	1
" 22	10 44 40	+1 21.84	− 8 18.3	20.4	21	16 21.85	9.311	+21 24 22.0	0.455	F	2
Oct. 4	8 17 34	+0 29.62	− 4 6.5	20.4	21	25 44.36	8.385n	+15 46 44.8	0.537	F	3
" 6	10 44 26	−1 38.54	−11 6.8	20.4	21	28 3.58	9.439	+14 44 49.7	0.592	F	4
" 7	9 50 35	+1 42.66	+ 8 4.3	20.4	21	29 9.19	9.259	+14 7 38.5	0.578	F	5
Nov. 5	7 16 38	−0 48.27	+ 5 54.6	20.4	22	19 44.96	8.590	+1 29 9.9	0.728	F	6

ADOPTED MEAN POSITIONS OF COMPARISON STARS.

Star.	α 1884.0	δ 1884.0	Authority.
	h m s	° ′ ″	
1	21 17 4.90	+21 51 43.6	* Bonn, VI + 21°: 4,531.
2	21 14 57.63	+21 32 10.4	Weisse, (2) 21, 319.
3	21 25 11.45	+15 50 21.3	Weisse, 21, 550.
4	21 29 38.85	+14 55 26 6	Weisse, 21, 699.
5	21 27 23.28	+14 9 4.4	Weisse, 21, 610.
6	22 20 30.07	+1 22 44.9	Weisse, 22, 399.

The circumstances of the annular solar eclipse for March are as follows:

	h m
Eclipse begins.....March 16,	3 17.4, Washington M. T.
Central eclipse begins	4 39.6,
Central eclipse ends..	6 51.7,
Eclipse ends	8 13.9,

In the northwestern part of the United States the eclipse will appear annular; partial elsewhere.

The partial eclipse of the *Moon*, March 29-30 will be visible at Washington.

MAGNITUDE OF LACAILLE 8802.

The magnitudes of this star from the catalogue at my disposal are are as follows:

Lacaille	8802,	Mag.	7	(1)
Taylor	9913,	"	6.7	(3)
Aoe$_2$	21353,	"	7	(1)
Lamont	718,	"	6.7	(2)
Wash. Mu. Z.	46,	"	6	(1)
Wash. Mu. Z.	184,	"	8.9	(1)
Wash. Mu. Z.	193,	"	8.7	(1)
Wash. M. C. Z.	148,	"	5	(1)
Tacchini	1867.8316,	"	8	(1)
Wash.Obs',1868,Sept.19,		"	5.7	(1) Transit.
Wash.Obs',1868,Sept.21.		"	5.7	(1) Transit.
Stone, C. G. H.		"	7	(3)
Holden, 1883, Sept. 30.		"	7	

Although the estimates of magnitude in the Washington Zones are not very trustworthy, the other estimates exhibit an unusual range. The star is not in GOULD'S Zones. It is also not in the Uranometria Argentina and is presumably not above 7 Mag. for this reason. My own estimate was carefully made with the large Equatorial.

E. S. HOLDEN.

The following is the programme of work to be pursued at the U. S. Naval Observatory at Washington, D. C., during the year beginning January 1, 1885, as transmitted by Commodore S. R. FRANKLIN, U. S. Navy, superintendent:

The Great Equatorial: First. Observations of a selected list of double-stars will be continued. These stars are such as have rapid orbital motions, or which present some other interesting peculiarity. Second. Conjunctions of the inner satellites of *Saturn* during the opposition of the planet will be observed. There will also be made a complete micrometrical measurment of the dimensions of the ring. Third. There will be made three drawings of *Saturn*—one before one at or near opposition; and one after opposition. Fourth. The observations which have been begun for stellar parallax, and for the temperature co-efficient of the screw of the micrometer, will be finished.

The Transit Circle: First. Observations of the *Sun* will be made whenever the necessary ephemeris stars can be observed, and the required instrumental corrections determined. Second. The *Moon* will be observed through the whole lunation. Third. The major planets will be observed from fifteen to twenty times, near opposition. Fourth. Each minor planet will be observed at least five times, near opposition. Fifth. Observations of the list of miscellaneous stars will be finished as soon as practicable.

The Transit Instrument: First. Observations will be made as often as practicable for time, for the correction of the standard mean time clock; and computations will be made daily for such correction Second. Observations for the right ascensions of the *Sun*, *Moon* and inner planets to be made as frequently as possible; observations of the major planets, and of the brighter of the minor planets, to be made near opposition. Third. The observations made during 1883 will be prepared for publication; and the computations of those of 1884 continued.

The 9.6-*Inch Equatorial*: Observations will be made—First. Of all the minor planets whose brightness at opposition is greater than their mean brightness. Second. Of comets, to determine position and physical peculiarities. Third. Of occultations of stars by the *Moon*. When arrangements shall have been made to photograph the *Sun*, any Sun-spots which show any decided peculiarites in the photographs will be examined with the spectroscope.

The Prime Vertical Transit Instrument: Observations of a selected list of stars in conjunction with the Royal Observatory at Lisbon, in pursuance of the plan recommended by the International Geodetic Association, for the determination of variability of latitude.

Time-Service and Chronometers: The time-balls at Washington and New York will be dropped daily at noon of the 75th meridian; and the noon signals will be extended to such other places throughout the country as may be desirable, as rapidly as arrangements may be made. The rating of chronometers will be continued as heretofore. Meteorological observations will be made as usual.

The Mural Circle: Observations will be made of stars down to the 7th magnitude south of ten degrees north declination, the positions of which have not yet been recently determined at some northern observatory; the observing list to be formed of all stars from GOULD'S Uranometria Argentina visible here, and not found in YARNALL'S Catalogue, the Transit Circle list of B. A. C. stars, or the recent Catalogue of the Glasgow Observatory.

THE WARNER ASTRONOMICAL PRIZES, $400.

It is a gratifying fact that very many astronomical discoveries, and those of great importance have been made during the past few years. I think this is due in part to the impetus given by competition for the honors and prizes awarded to discoverers, and in order that this interest may to that extent be continued and sustained, I offer

First. Two hundred dollars for each and every discovery of a new comet made from February 1st, 1885, to February 1st, 1886, subject to the following conditions:

1. It must be discovered in the United States, Canada, Mexico,

West Indies, South America, Great Britain and the Australian Continent and Islands, either by the naked eye or telescope, and it must be unexpected, except as to the comet of 1815 which is expected to reappear this year or next.

2. The discoverer must send a prepaid telegram immediately to Dr. LEWIS SWIFT. director Warner Observatory, Rochester, N. Y., giving the time of the discovery, the position and direction of motion with sufficient exactness, if possible, to enable at least one other observer to find it.

3. This intelligence must not be communicated to any other party or parties, either by letter telegraph or otherwise, until such time as a telegraphic acknowledgement has been received by the discoverer from Dr. SWIFT. Great care should be observed regarding this condition, as it is essential to the proper transmission of the discovery, with the name of the discoverer, to the various parts of the world, which will be immediately made by Dr. SWIFT. Discoverers in Great Britian, the Australian Continent and Islands, West Indies and South America are absolved from the restriction in conditions 2nd and 3d.

Second. I will also give a prize of $200 in gold to any person in the world who will write the best paper containing three thousand words on the cause of the atmospheric effects ("red light," etc.,) accompanying sunset and sunrise during the past sixteen months. It is desired that these papers be as original as possible, both in facts, observations and treatment.

Essays must be exclusively sent prepaid to Dr. LEWIS SWIFT, Director Warner Observatory, Rochester, New York, must be written in English, on one side of paper only, with ink, and must be in the simplest, untechnical phrase. Each competitor must sign a *nom de plume* to his essay, and enclose his real name and address in an envelope, superscribed with his *nom de plume*. The essays must be in Dr. SWIFT's hands by December 1, 1885.

Three disinterested scientists will be selected to determine the result, and also to settle any dispute that may arise regarding comet discoveries. H. H. WARNER.

Rochester, N. Y., Jan. 17, 1885.

Our thanks are due to the large number of subscribers who have promptly renewed their subscriptions to the new volume. If the MESSENGER should fail to visit any, in the future, it will be probably because the publisher thinks it is not longer wanted.

The following list of subscriptions and orders, not previously ac knowledged has been received:

Henry W.Parkhurst, Brooklyn, N. Y.; Prof. E. S. Holden, Madison, Wis.; J. Hagan, S. J., Prairie du Chien, Wis.; George C. Hill,

Rosemond, Ill.; C. W. Tallman, Batavia, N. Y.; Geo. B. Merriman, New Brunswick, N. J.; Wm. Strong, Kalamazoo, Mich.; Geo. W. Pritchard, Providence, R. I.; J. P. D. John, De Pauw University, Greencastle, Ind.; Charles H. Rockwell, Tarrytown, N. Y.; John H. Eadie, Bayonne, N. J.; J. H. Devor, Elkhart, Ind.,; "Mechanics Institute," San Francisco, Cal.; Dr. C. H. F. Peters, Litchfield Observatory, Clinton, N. Y.; John D. Elliott, St. Louis, Mo.; Prof. Geo. M. Phillips, West Chester, Pa.; Frank W. Bailey, Erie, Pa.; Jas. S. Lawson, U. S. Coast and Geod. S., San Francisco, Cal.; C. E. Crane, Waseca, Minn.; A. K. Funk, Elkhart, Ind.; G. W. Cheesman, Ansonia, Conn.; S. W. Burnham, Chicago, Ill.; Mrs. J. H. Levengood, Honeybrook P. O., Pa.; M. A. G. Meads, Buffalo, N. Y.; Prof. H A. Howe, Denver Colorado; College Library, Albion, Mich.; S. H. Freeman, Cleveland, Ohio; Prof. R. W. McFarland, Columbus, Ohio; J. Stahn, 34 Ensor street. Baltimore, Md.; J. W. Thompson, Salem, Ohio; C. G. Miller, Fayette. Fulton county, Ohio; University Reading Room, Eugene, Oregon; Sarah F. Whiting, Wellesley College, Wellesley Mass., (Vols. 3 and 4;) Anna Winlock, Harvard College Observatory, Cambridge, Mass.; Mrs. L. S. Burnham, 187 Schermerhorn street, Brooklyn, N. Y.; Chester Guild, 88 Summer street, Boston, Mass.; Miss Mary W. Bronson, Pennsylvania College, Pittsburg, East End, Penna.; Wm. P. Wheeler, Homestead, Louisville, Ky.; Dr. M. S. Dowling, Leslie, Mich.; Cyrus F. Raine, Rochester, N. Y.; F. H. Dickey, 80 La Salle street, Chicago; Wm. B. Phelps, Fargo, Dakota Territory,

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QUERIES.

1. Will some readers of the SIDEREAL MESSENGER kindly describe an inexpensive, but effective, method for illuminating micrometer wires? (RIGEL.)

2. What are the comparative merits of drawing and photography in astronomical work? P. W.

3. What is the cause of the black transit of *Jupiter's* satellites? P. W.

4. Will some one give information by which to secure a good but inexpensive star-map for amateur study? S. M.

5. A book giving the correct pronunciation of the names of the stars is desired. S. M.

ASTRONOMICAL PAPERS

The following are the titles of a few important astronomical papers recently published:

Formulas for Computing the position of a Satellite, by Professor ASAPH HALL, Washington, D. C.

Theories Regarding the *Sun's* Corona, by Professor C. A. YOUNG, Princeton, N. J.

Photography—Glass Negatives by the Dry Plate Process, by Professor W. H. PICKERING, Boston, Mass.

The Lick Observatory of California, by Professor S. NEWCOMB, Washington, D. C.

Accurate Measurement of Time, by THEODORE B. WILSON: *Popular Science Monthly*, March, 1885.

The New Astronomy, IV.—The Planets and the *Moon*, by Professor S. P. LANGLEY: *The Century* for March, 1885, fully illustrated.

Needed Star Surveys, by RICHARD A. PROCTOR, in *Knowledge* for February, 1885.

BOOK-NOTICE.

Elements of the Differential and Integral Calculus, by JAMES M. TAYLOR, Boston, GIN, HEATH & Co., 1884; pp. 236.

This concise treatise on the Calculus seems suited to a course of about twenty weeks' study, for an average class. It covers nearly the same range of topics as BOWSER'S or OLNEY'S work on the same subject, though in a different manner. The first twelve chapters (excepting chapters III and V) are devoted to the Differential Calculus. Chapters III, V and XIII-XVI give the elements of the Integral Calculus, together with numerous applications to Geometry and Mechanics, which serve to stimulate the interest to the pupil. The author has employed the method of rates, but coordinated with it, the method of limits, proving many principles by both methods; he avoids the use of the fraction $\frac{0}{0}$. The exercises for solution are abundant and well chosen. H. A. H.

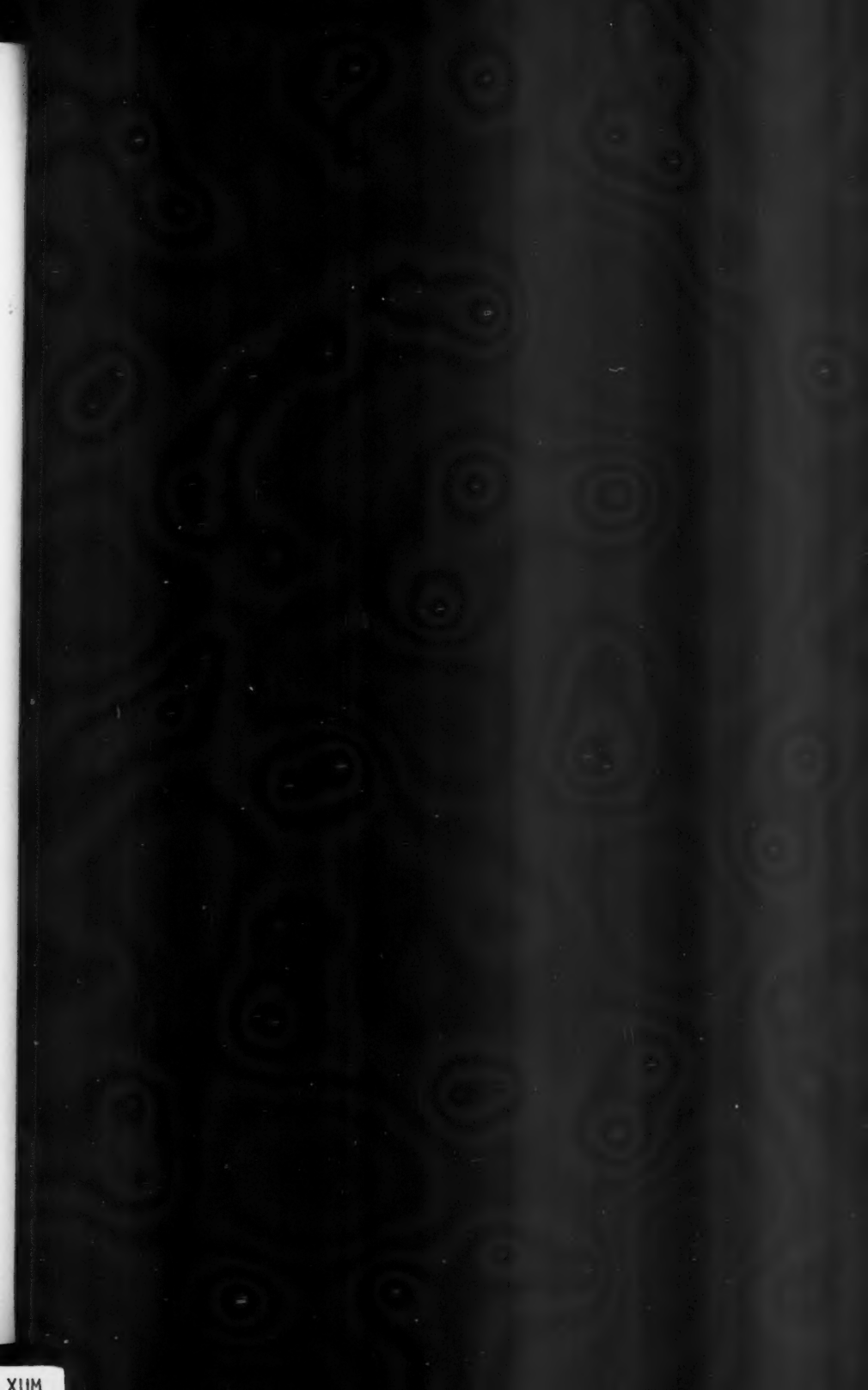
American Journal of Mathematics.—Volume VII, Number 2, of the *American Journal of Mathematics* has just appeared, and contains the following articles:

"A Memoir on the Abelian and Theta Functions," by Professor CAYLEY. This is the continuation of Professor CAYLEY'S great memoir, the first three chapters of which appeared in Volume V of the *Journal*. The present article chapters IV–VII, and treats principally of the case where the "fixed curve" is a quartic both in plane and in space.

"Solution of Solvable Irreducible Quintic Equations without the aid of a Resolvent Sextic, by GEORGE PAXTON, of University College, Toronto. Professor YOUNG assumes JERRARD'S trinomial form for the quintic, finds the criterion of ts solvability, and finally solves the equation in all possible cases.

A note on "Maclaurin's Theorem, by M. HERMITE.

The first part of memoir on the "Algebra of Logic, by Mr. C. S. PEIRCE, in which the author studies the philosophy of notation.



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CALENDAR.

Winter Term begins Wednesday, Jan. 7, 1885; ends March 19, 1885.
Term Examinations March 18 and 19, 1885.
Spring Term begins Wednesday, April 1, and ends June 18, 1885.
Examinations to enter College, June 12 and 13, and Sept. 8, 1885.
Term Examinations, June 16 and 17, 1885.
Anniversary Exercises, June 15–18, 1885.
Exhibition at the Art Room of work of Pupils in Drawing and Painting, June 15–18, 885.
Wednesday, September 9, 1885, Fall Term begins.
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